

Understanding How to Improve Clarity & Consistency in Project Controls with BIM

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Agenda

1

Virtual Design and Construction & Project Controls

2

Standards, Methods and Procedures

3

Scaling Up Delivery

Learning Outcomes

At the end of this session participants will be able to:

- Understand the opportunities and rationale for digitalization
- Understand BIM basics and the benefits
- Describe industry BIM requirements, the basic process for creating data models and how that supports downstream uses
- Explain the use of BIM for design (3D), scheduling (4D), cost estimation and control (5D), sustainability and carbon analysis (6D) and asset data management (7D).
- Describe the role of BIM in the wider digitalization of the engineering department.



Digitalization in Infrastructure



Billion Dollar Technology Companies



The Need for Digitalization

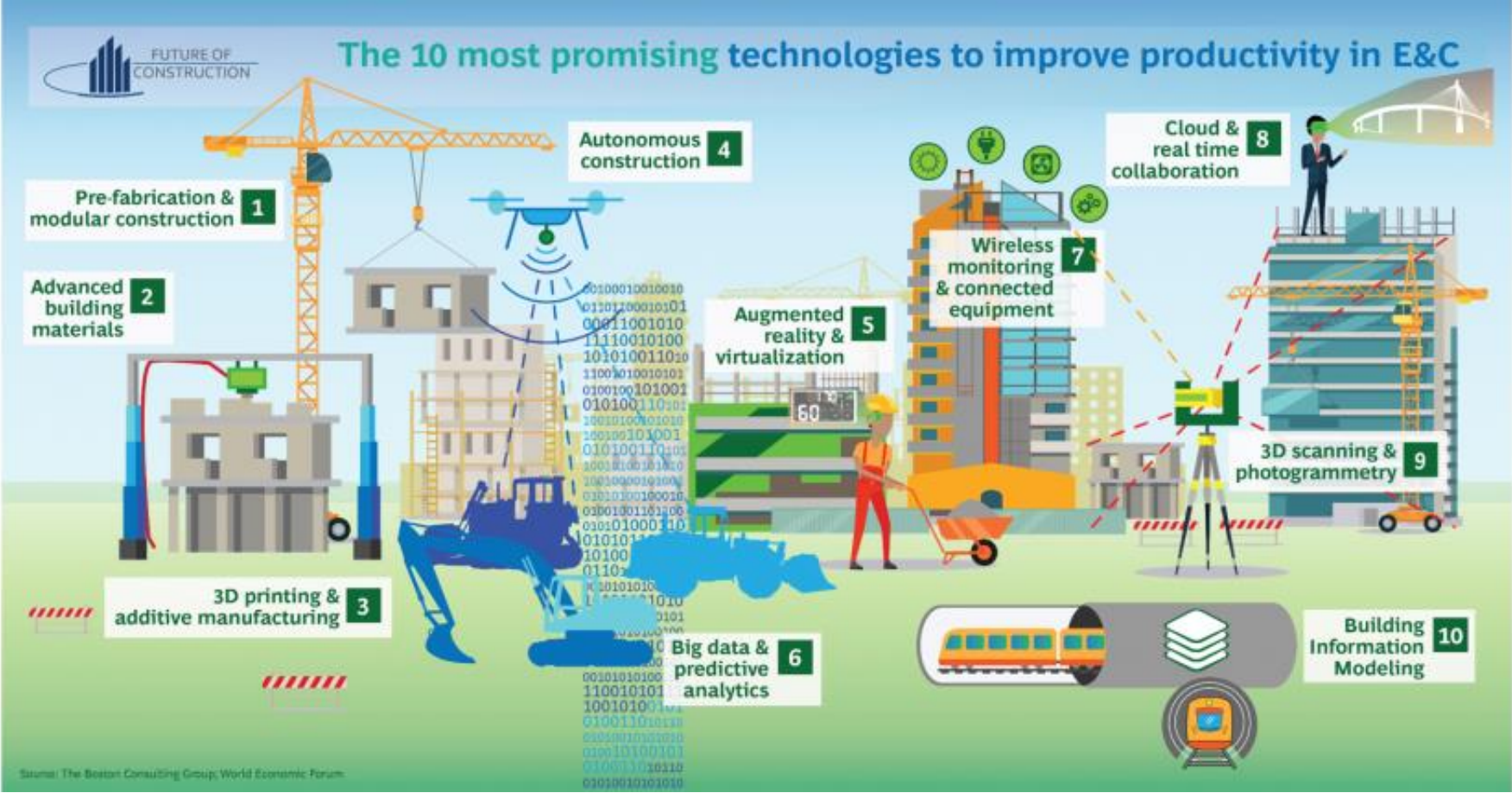


Projects are typically **20 percent longer** than scheduled and up to **80 percent over budget**.

Low digitization and high fragmentation.



Evolution of Technology



VDC and Project Controls



What is BIM?



What is BIM?

DATA



SORTED



ARRANGED

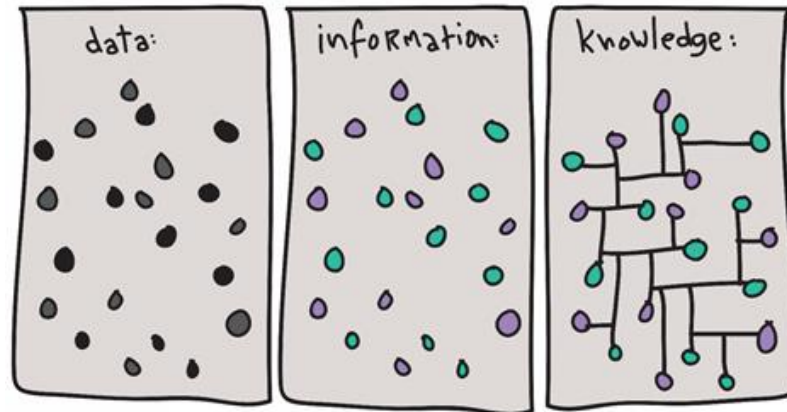
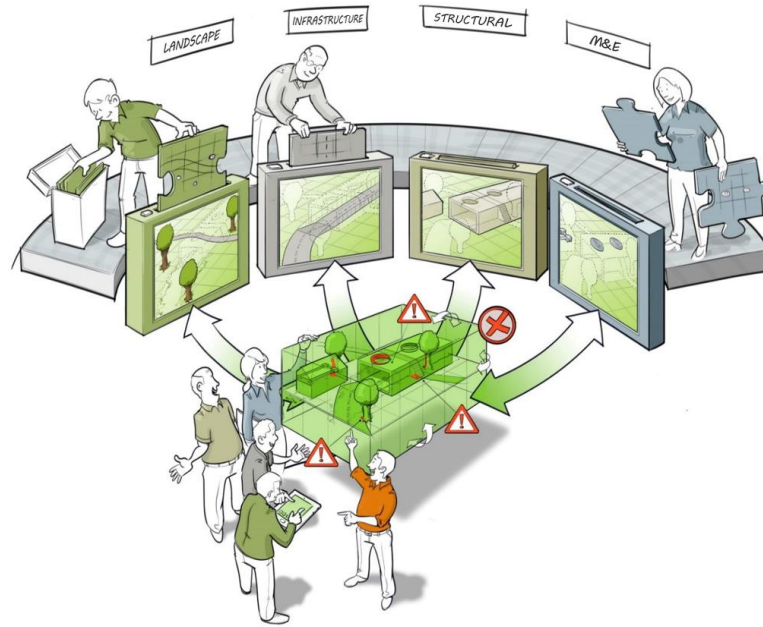
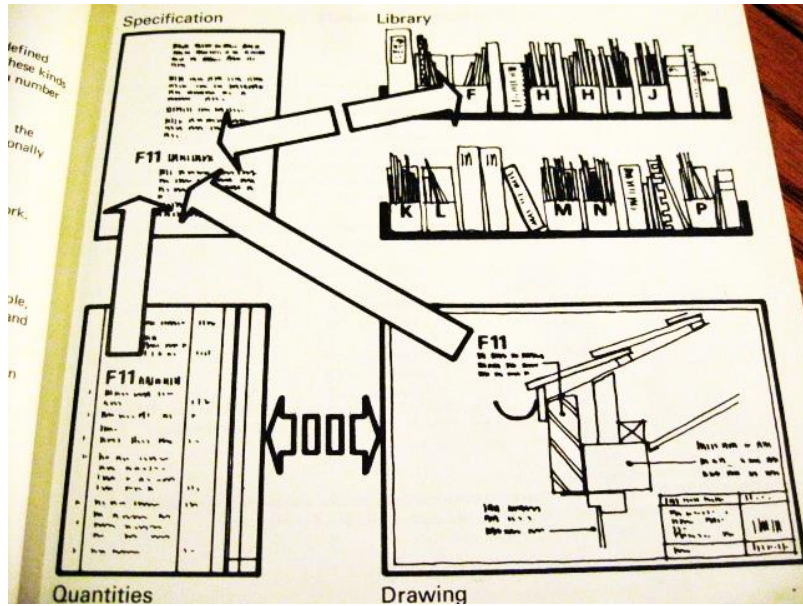


PRESENTED VISUALLY



Image: Lego Infographics

What is BIM?



What is BIM?



3D



4D



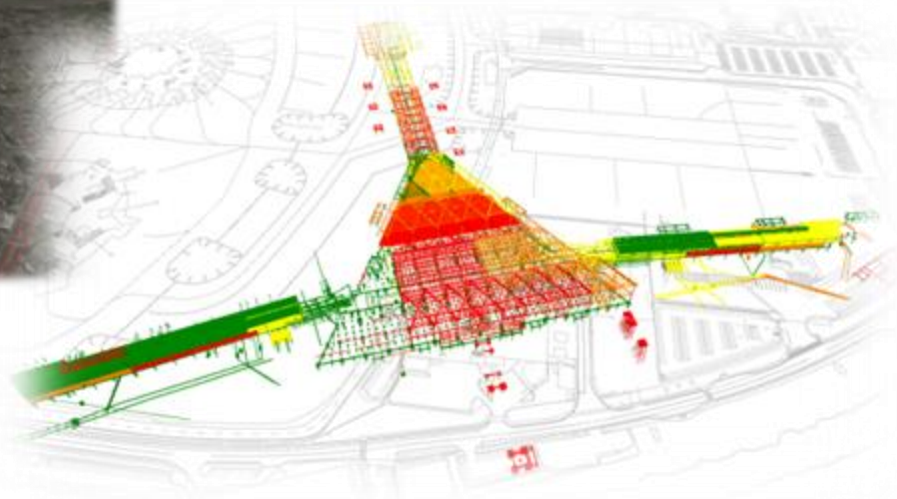
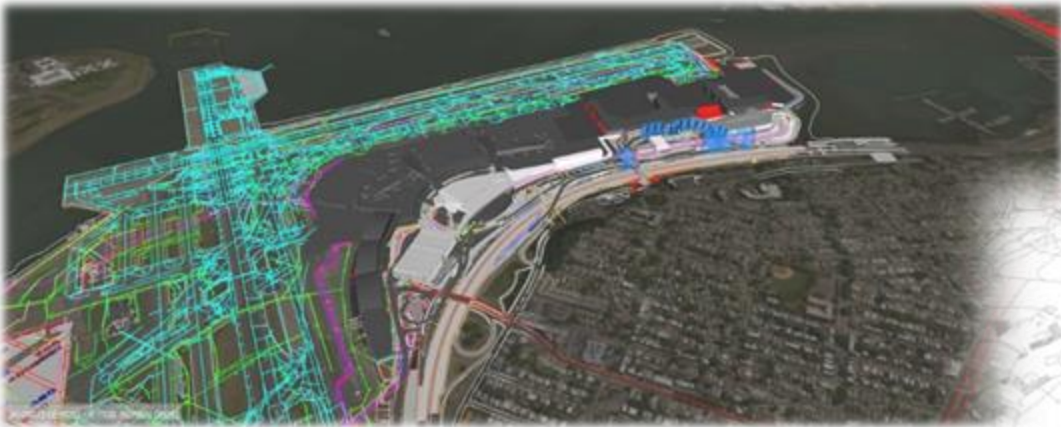
5D



6D



7D



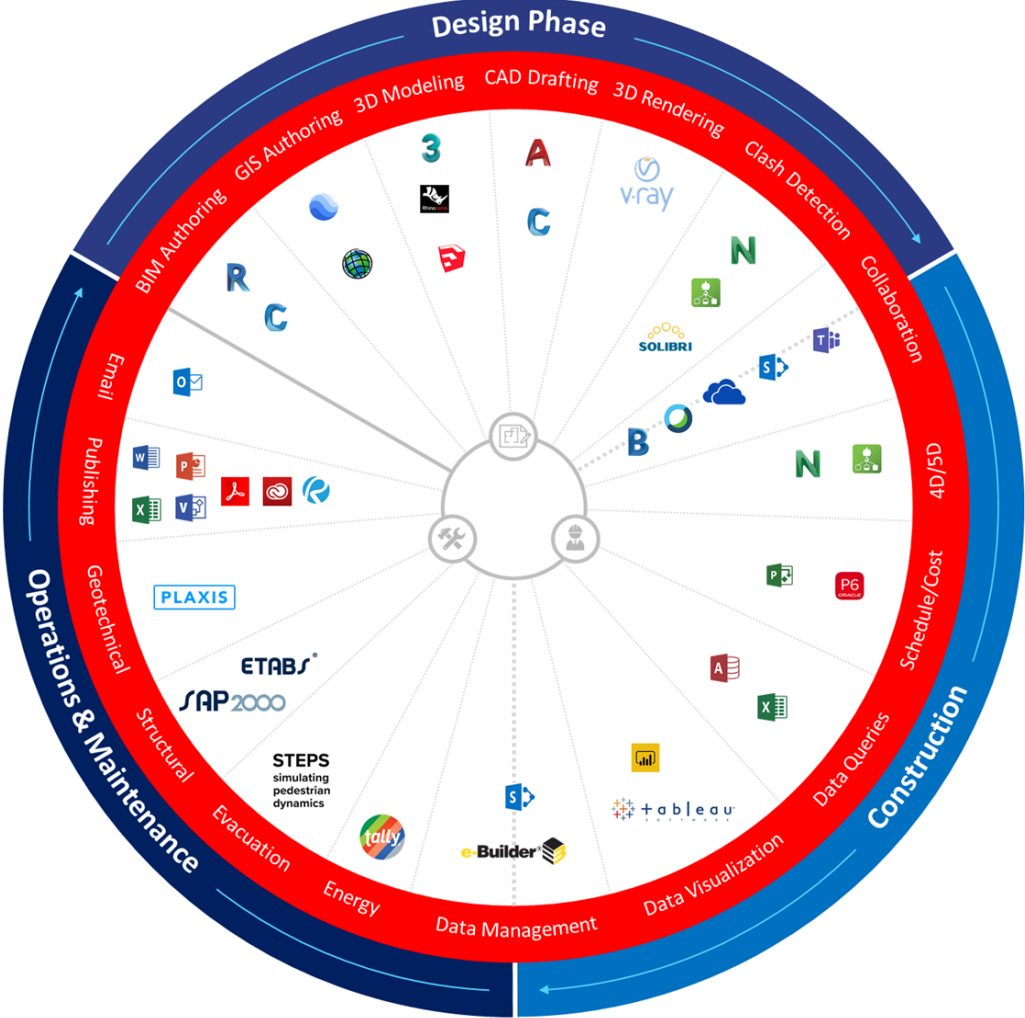
Engineering, BIM and Controls

| | |
|---------------------------|-----------------|
| Design / Scope | 3D |
| Schedule Control | 4D |
| Cost Management | 5D |
| Risk Management | 3D, 4D, 5D & 7D |
| Sustainability | 6D |
| Construction and Handover | 3D, 4D, 5D & 7D |

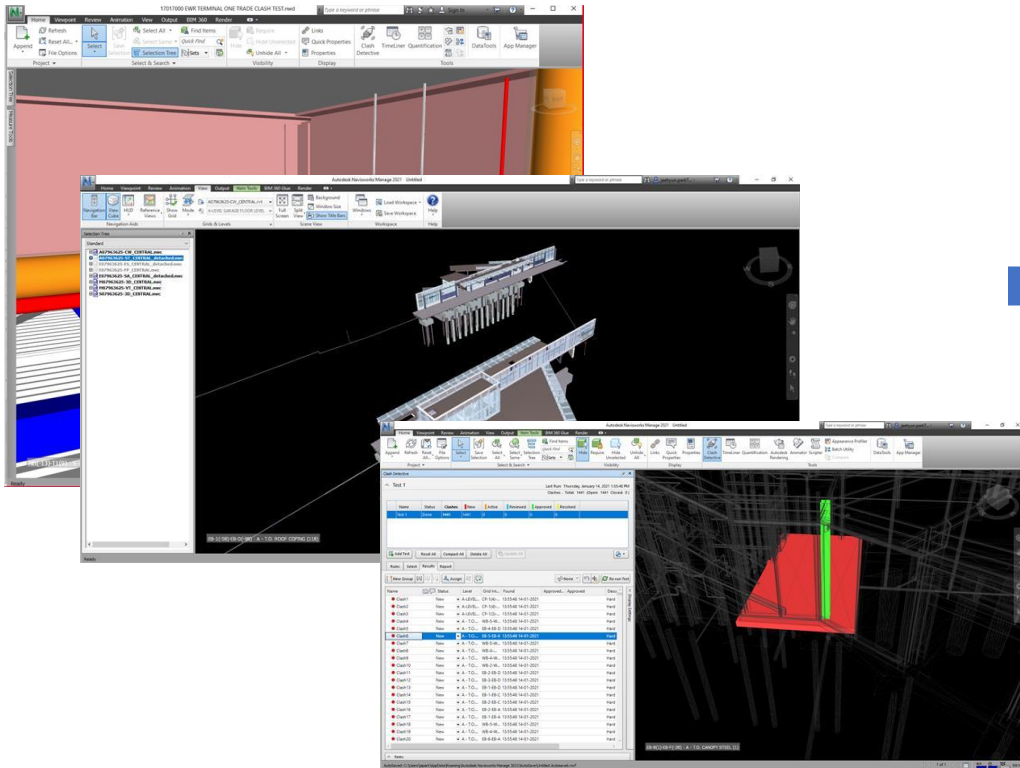
Document / Information / Records Management



Technology Ecosystem



3D Design Model



Newark Liberty International Airport
Terminal One Redevelopment

Trade Coordination (Current)

| Sector | EX | PRCD_GRILL | PRCD_SLAB | Rectangular Duct | Standard Clevis Hanger | Total |
|--------|----|------------|-----------|------------------|------------------------|-------|
| 14 | 4 | 1 | | | | 749 |
| 13 | 4 | 1 | | | | 500 |
| 15 | 2 | | | | | 491 |
| 28 | | | | | | 490 |
| 16 | 5 | 1 | 1 | | | 369 |
| 31 | | | | | | 347 |
| 34 | | | | | | 344 |
| 17 | | | | | | 338 |
| 38 | | | | | | 8 |
| 8 | | | | | | 5 |
| 5 | | | | | | 32 |
| 37 | | | | | | 20 |
| 10 | | | | | | 12 |
| 20 | | | | | | 10 |
| 33 | | | | | | 4 |
| 12 | | | | | | 3 |
| 3 | | | | | | 21 |
| 11 | | | | | | 18 |
| 24 | | | | | | 2 |
| 2 | | | | | | 4 |

Discipline (Model 1): Electrical, Environmental, Mechanical
Discipline (Model 2): Electrical, Environmental, Mechanical, Structural

Sector: Level: 8.735
Clashes: 0

Space Projections

| Room Name | Room No. | Area | Remarks |
|------------------------|----------|----------|---------|
| DOMESTIC WATER SERVICE | 01 | 250 SF | |
| BATHROOM | 02 | 41 SF | |
| JANITOR'S CLOSET | 03 | 26 SF | |
| CORRIDOR | 04 | 3534 SF | |
| MV SWITCHGEAR ROOM | 05 | 1697 SF | |
| HV SWITCHGEAR ROOM | 06 | 1010 SF | |
| OPERATORS ROOM | 07 | 375 SF | |
| BATTERY ROOM 2 | 08 | 173 SF | |
| HV SWITCHGEAR ROOM | 09 | 925 SF | |
| HV SWITCHGEAR ROOM | 10 | 1010 SF | |
| MV SWITCHGEAR ROOM | 11 | 1480 SF | |
| | | 145 SF | |
| | | 500 SF | |
| | | 915 SF | |
| | | 640 SF | |
| | | 640 SF | |
| | | 641 SF | |
| | | 640 SF | |
| | | 640 SF | |
| | | 106 SF | |
| | | 17600 SF | |

Port Authority of New York and New Jersey
Harrison Southwest Station

pathlink 1.5 (Family) Conduit Fittings Conduits E07963625-SP01-Site Plan.dwg Electrical Equipment Electrical Fixtures Rooms Total

| | | | | | | | |
|----------------------|---|---|----|---|----|----|----|
| Pipes | 1 | | 11 | 8 | 26 | 46 | |
| Pipe Fittings | 1 | | | 1 | 15 | 17 | |
| Mechanical Equipment | | | | 6 | 1 | 4 | 11 |
| Duct Accessories | 2 | 2 | | | | 3 | 7 |
| Ducts | | | | 6 | | 6 | |
| Fire Alarm Devices | | | | | 3 | 3 | |
| Plumbing Fixtures | | | 2 | | | 2 | |
| Duct Fittings | | | | 1 | | 1 | |
| Pipe Accessories | | | 1 | | | 1 | |
| Walls | | | | | 1 | 1 | |

Trade Coordination (Summary)

| Data Date | Type | Status |
|-----------|------|--------|
| All | Hard | new |

Model 1: E07963625
Model 2: E07963625
Clashes: 95

| Discipline | M07963625 | Totals |
|------------|-----------|--------|
| E07963625 | 95 | 95 |
| Model 1 | 95 | 95 |

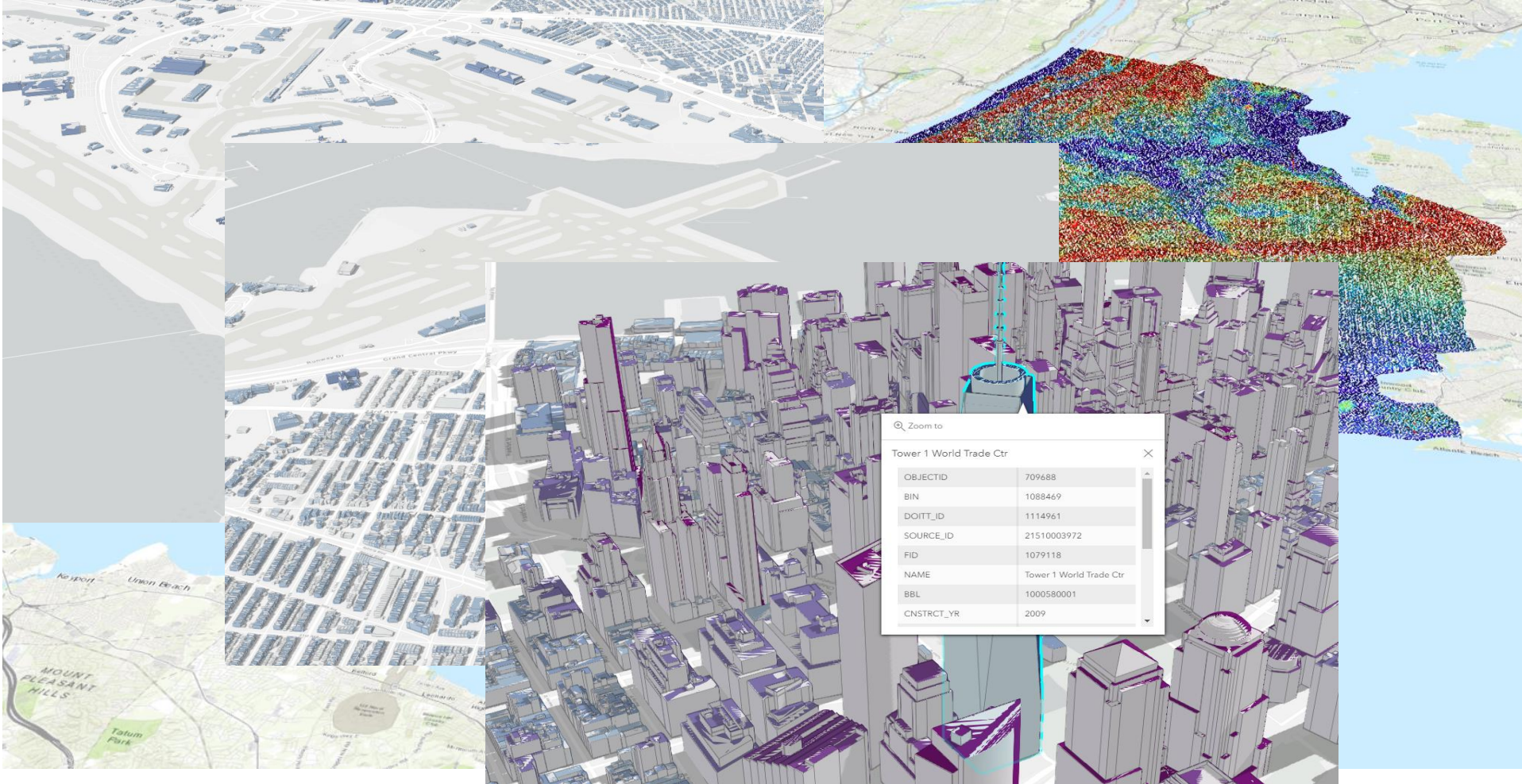
REFRESH DATE: DECEMBER 2020 VERSION: 1.3

Benefit: Target zero clashes at 100% design

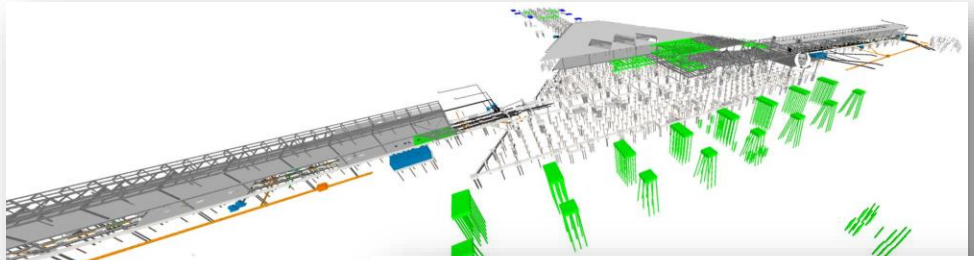
The Shared Information Model



3D Design Model



4D - Scheduling Sequencing and Simulation



Newark Liberty International Airport
Terminal One Redevelopment

Overhead Signage Construction Status

| Signage ID | Fitout Status |
|------------|---------------|
| OH-1 | Critical |
| OH-10A | Critical |
| OH-11 | Critical |
| OH-12 | Critical |
| OH-13 | Critical |
| OH-16 | Critical |
| OH-17 | Critical |
| OH-18 | Critical |
| OH-19 | Critical |
| OH-2 | Critical |
| OH-20 | Critical |
| OH-21 | Critical |
| OH-22 | Critical |
| OH-23E | Critical |
| OH-24E | Critical |
| OH-25E | Critical |
| OH-26E | Critical |
| OH-27E | Critical |
| OH-3 | Critical |
| OH-30E | Critical |
| OH-4 | Critical |
| OH-5 | Critical |
| OH-6 | Critical |
| OH-9 | Critical |

On Going Construction

- Terminal D/B
- Shared Work Area
- Bridges N61-63
- Building 331 Demo
- ConRAC
- Airside S PH2
- Airside N
- RSVR

Model Explorer Data SOURCES

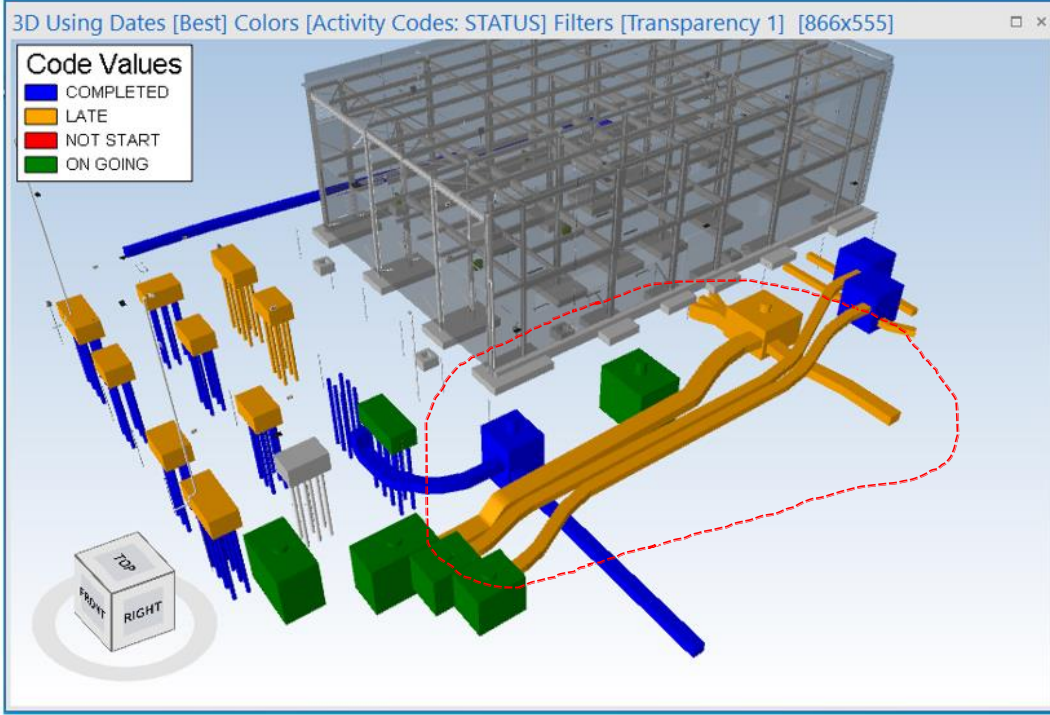
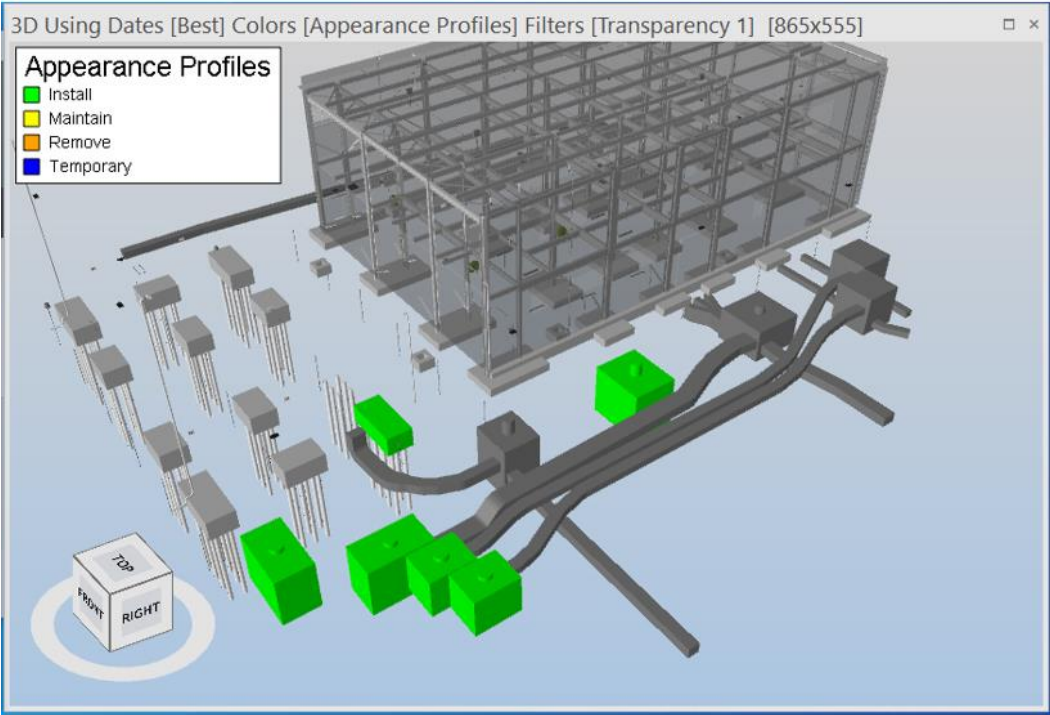
| Source Type | Status | Date Loaded |
|------------------------------|----------|--------------------------|
| Building | Vector | Imported Thu Dec 24 2020 |
| Building | Vector | Imported Thu Dec 24 2020 |
| Coverage Areas | Vector | Imported Thu Dec 24 2020 |
| Structure | Vector | Imported Thu Dec 24 2020 |
| Ground Imagery | Raster | Imported Thu Dec 24 2020 |
| Building | Vector | Imported Thu Dec 24 2020 |
| Railroad | Vector | Imported Thu Dec 24 2020 |
| Road | Vector | Imported Thu Dec 24 2020 |
| 3D Models | Vector | Imported Thu Dec 24 2020 |
| AIRTERMINAL_CENTRAL_3D Model | 3D Model | Imported Wed Jan 20 2022 |
| AIRTERMINAL_SOUTH_3D Model | 3D Model | Imported Wed Jan 20 2022 |
| Survey | Raster | Imported Thu Dec 24 2020 |
| Photogrammetry | Raster | Imported Thu Dec 24 2020 |

Visualize and interrogate progress using the 4D simulation model.

Visualize Work in Place to identify issues



Scheduling Solution

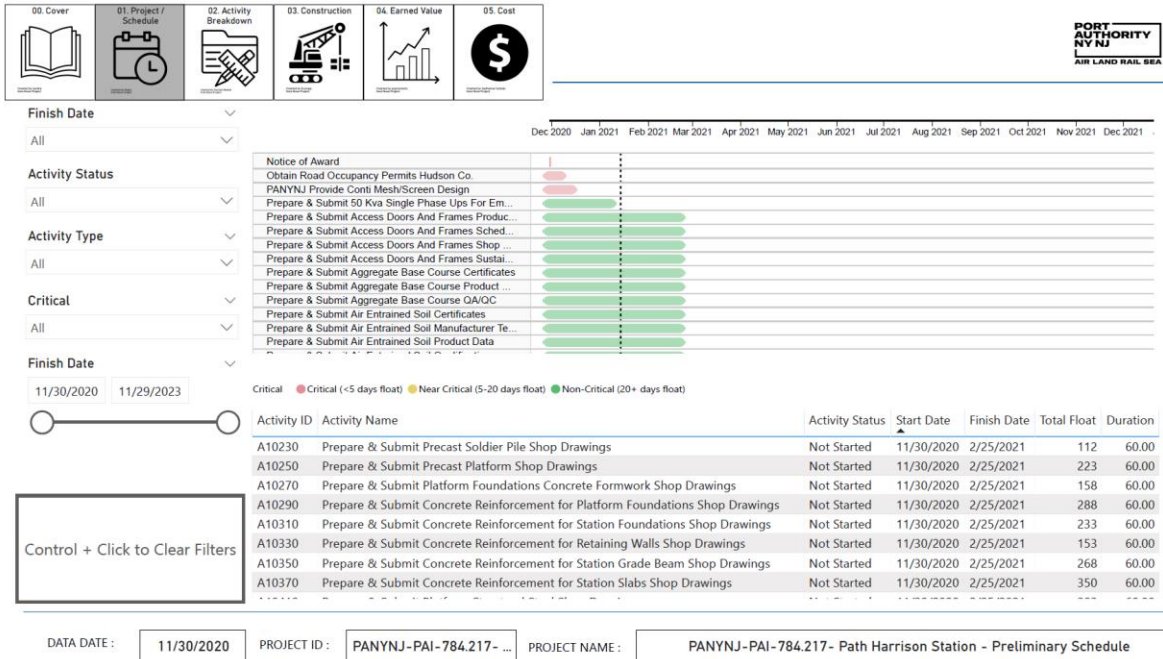


2. Visualize and interrogate progress

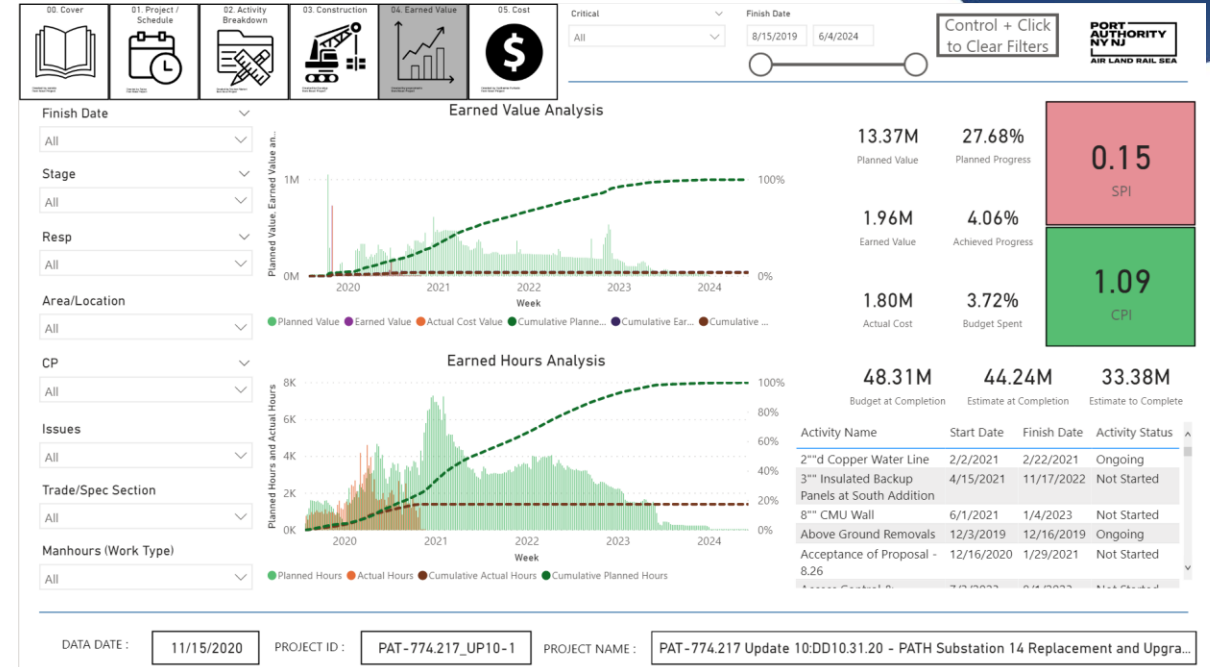
Visualize Work in Place to identify issues



4D - Scheduling Dashboard

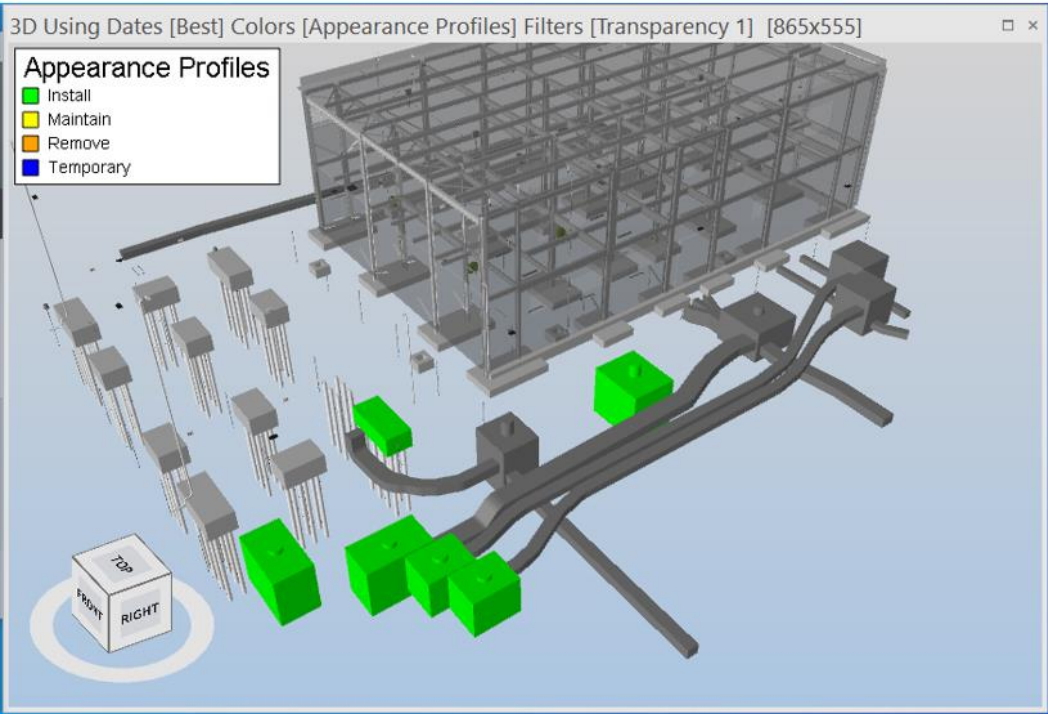


3. Analyze impact and mitigation to avoid delay.

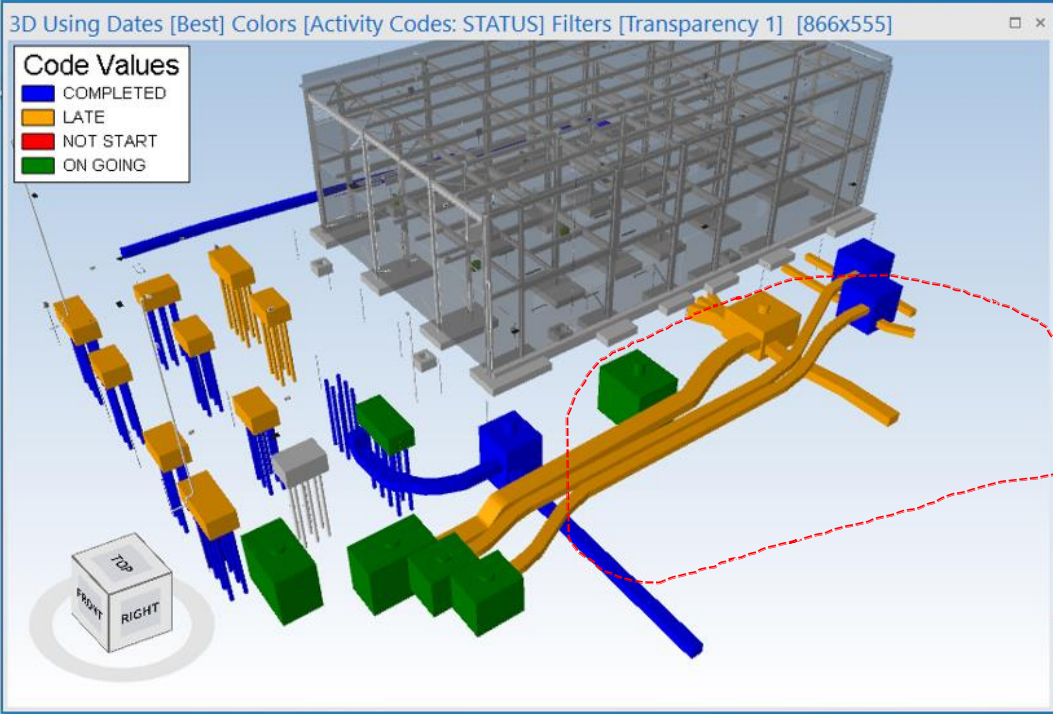


Avoid delays by forecasting completion.

Scheduling Solution

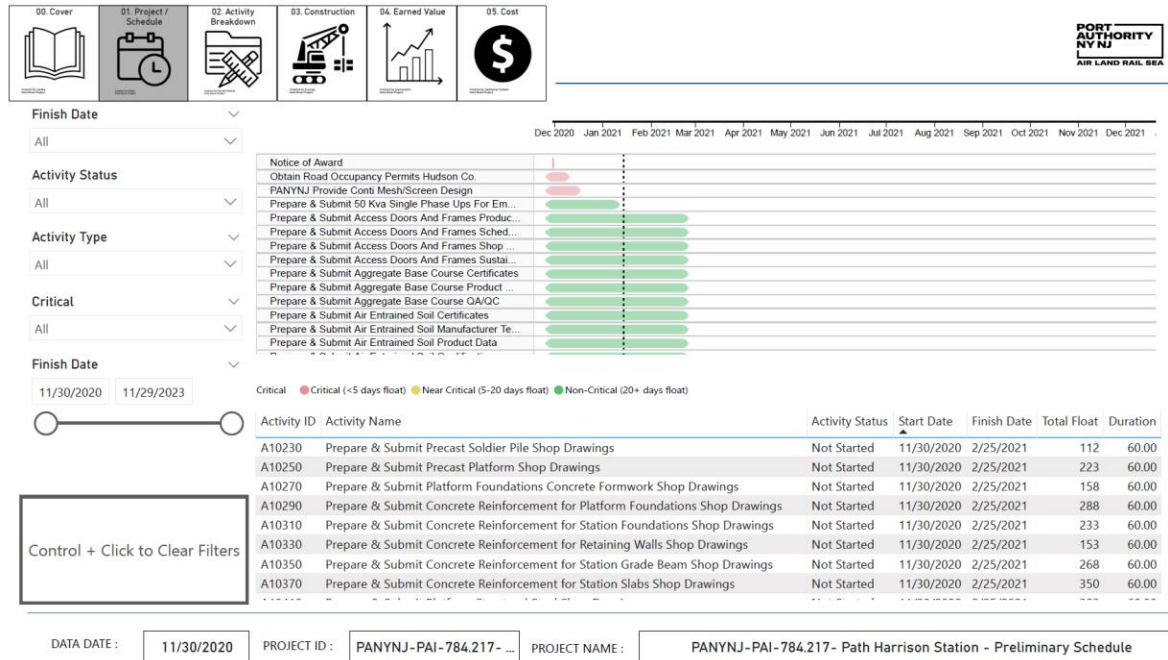


2. Visualize and interrogate progress

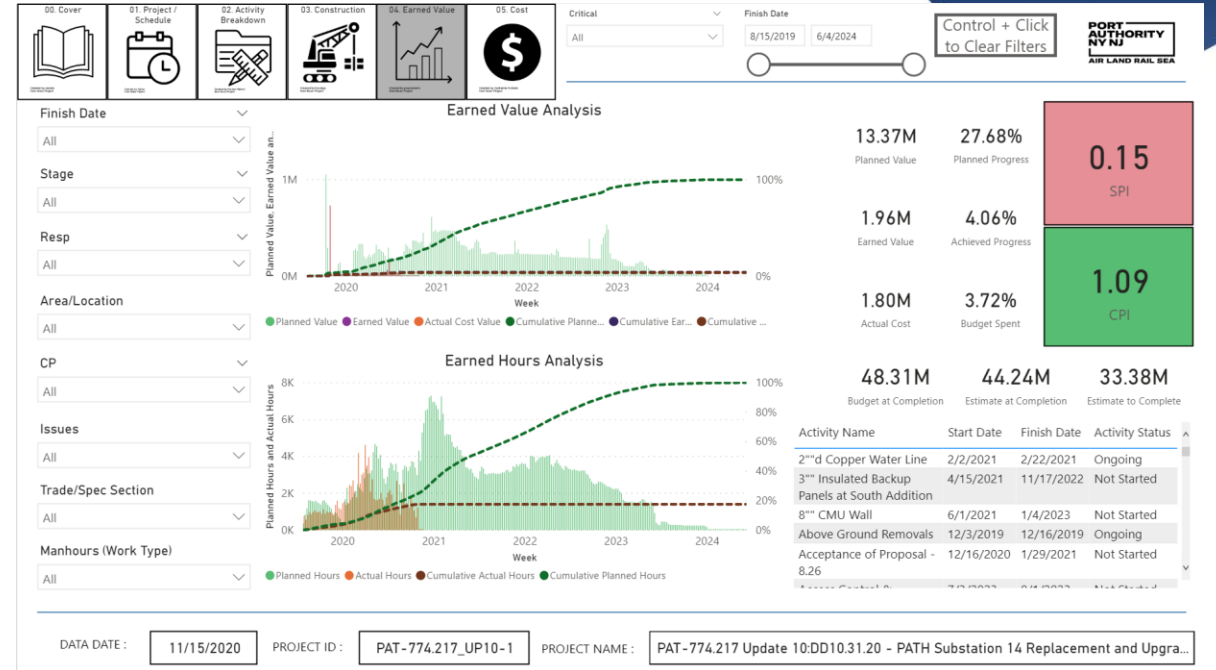


Visualize Work in Place to identify issues

4D - Scheduling Dashboard



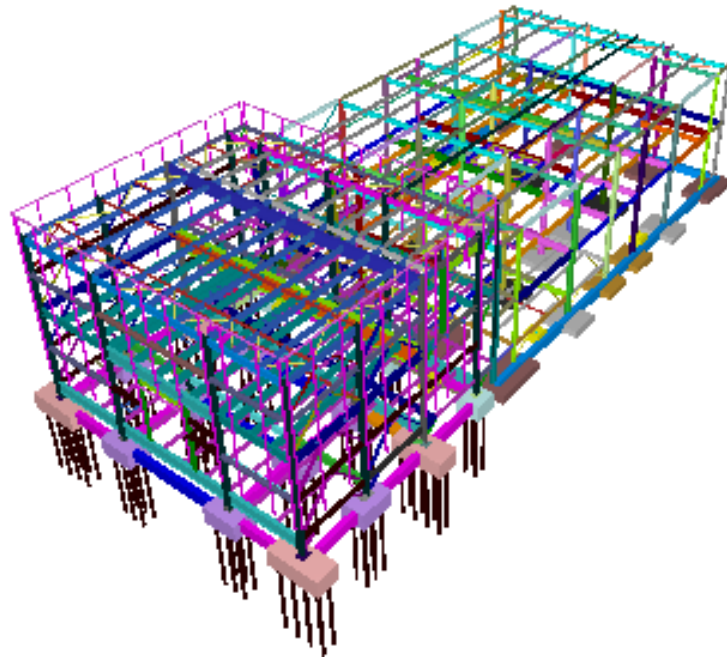
3. Analyze impact and mitigation to avoid delay.



Avoid delays by forecasting completion.



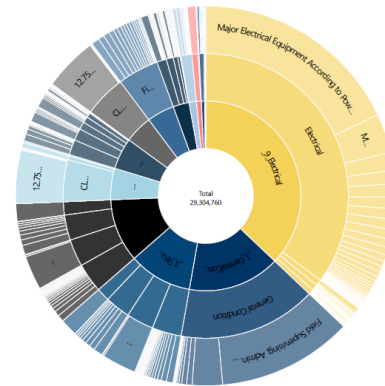
5D Cost Estimating and Control Model



Port Authority Trans-Hudson (PATH)
Substation Development

Cost by Table, Category and Description

Table ●_1_Genera... ●_10_Electr... ●_11_Enviro... ●_12_Geote... ●_12_Traffic... ●_18_Field... ●_2_Civil ●_3_Structu... ●_32_Classi... ●_4_Archite...



THE PORT AUTHORITY OF NY & NJ

Costs

Table
All

Category
All

Description
All

Show ...
 Equipment Cost
 Labor Cost
 Material Cost
 Total Cost

Ctrl + click to go back

Ctrl + click to clear filters after drillthrough

REFRESH DATE : NOVEMBER 2019

VERSION : 1.0

CONFIDENTIAL

Benefit: Accurate quantities and prices

5D

Cost Modeling

PORT AUTHORITY
NY NJ
AIR LAND RAIL SEA

Project Controls
EXPO
Washington, DC - USA

4D → 5D Model

The screenshot displays a software interface for project management, showing a transition from a 4D model to a 5D model. The interface includes a project tree on the left, a Gantt chart at the top, a table of task durations and budgets, an Earned Value Graph, a resource utilization bar chart, and a 3D model at the bottom.

Table Data (Highlighted Row):

| Name | Duration | Start | Finish | 3D Reso... | Budget at Completio... |
|--------------------------|----------|------------------|-------------------|------------|------------------------|
| 361000-3D-NEW_export.spx | 977d | 7:00 AM 8/2/2019 | 3:30 PM 6/29/2023 | (5477) | \$48,311,245.00 |
| 361000-3D_export.spx | 977d | 7:00 AM 8/2/2019 | 3:30 PM 6/29/2023 | | \$21,660,718.50 |
| 361000-4D.spx | 911d | 7:00 AM 8/2/2019 | 3:30 PM 3/28/2023 | | \$13,173,662.00 |

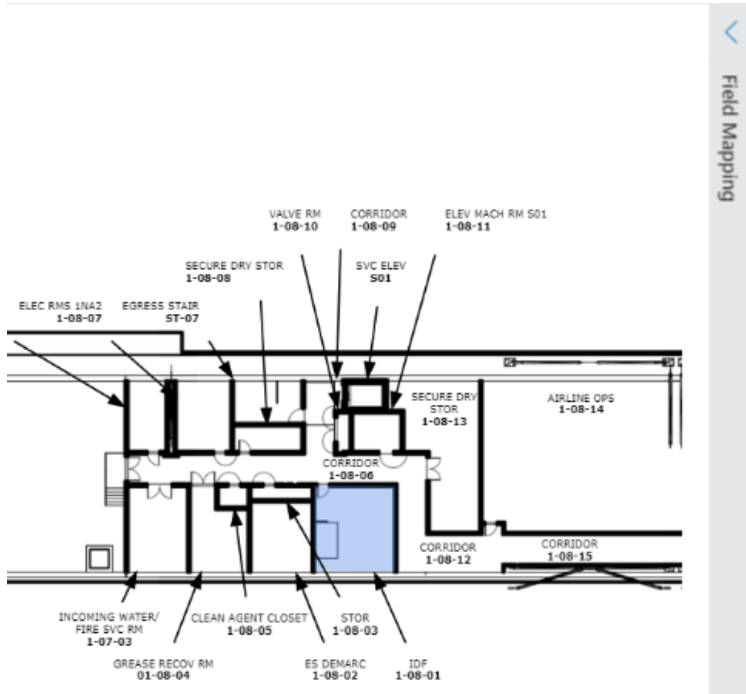
Earned Value Graph Data (Highlighted Point):

| Value | Label |
|-----------------|----------------------|
| \$29,979,881.69 | Current Earned Value |
| \$0.00 | Planned Value |
| \$0.00 | Actual Cost |

3D Properties Panel (Highlighted Fields):

| User Field | Value |
|------------------------------|------------|
| Area | 144.00 |
| Construction Status | Constr... |
| ElementID | 50612 |
| Elevation at Bottom | 5.50 |
| Elevation at Bottom Survey | -4.56 |
| Elevation at Top | 7.50 |
| Elevation at Top Survey | -2.56 |
| Enable Analytical Model | True |
| Family | CSF |
| Family and Type | CSF |
| Family Parameter: Assemb... | A1010 |
| Family Parameter: Assemb... | Footing |
| Family Parameter: Cost | 0.00 |
| Family Parameter: Family ... | Struct... |
| Family Parameter: Founda... | 2.00 |
| Family Parameter: Length | 16.00 |
| Family Parameter: OmniCl... | 23.25 |
| Family Parameter: OmniCl... | Shallow |
| Family Parameter: Type N... | CSF |
| Family Parameter: Width | 9.00 |
| Family Parameter: Workset | 751 |
| Height Offset From Level | -2.52 |
| Host | Level |
| Length | 16.00 |
| Level | S-LEV |
| Moves With Grids | True |
| Phase Created | Existin... |
| Rebar Cover - Bottom Face | Interior |
| Rebar Cover - Other Faces | Interior |
| Rebar Cover - Top Face | Interior |
| Structural Material | Concre |
| Type | CSF |
| Type Id | CSF |
| UID | 06612 |
| Volume | 288.00 |
| Width | 9.00 |
| Workset | Founda |

7D Asset Data Model



Field Mapping

Level Sector

Room / Grid Zone System

Function (Type) Sub-System

Family

| Level | Sector | Room # | Unique Asset ID (UAID) |
|-------|--------|--------|-------------------------|
| 1 | 8 | 1 | AVIA_EWR_T001_A-0A_L001 |
| 1 | 8 | 1 | AVIA_EWR_T001_A-0A_L001 |
| 1 | 8 | 1 | AVIA_EWR_T001_A-0A_L001 |
| 1 | 8 | 1 | AVIA_EWR_T001_A-0A_L001 |



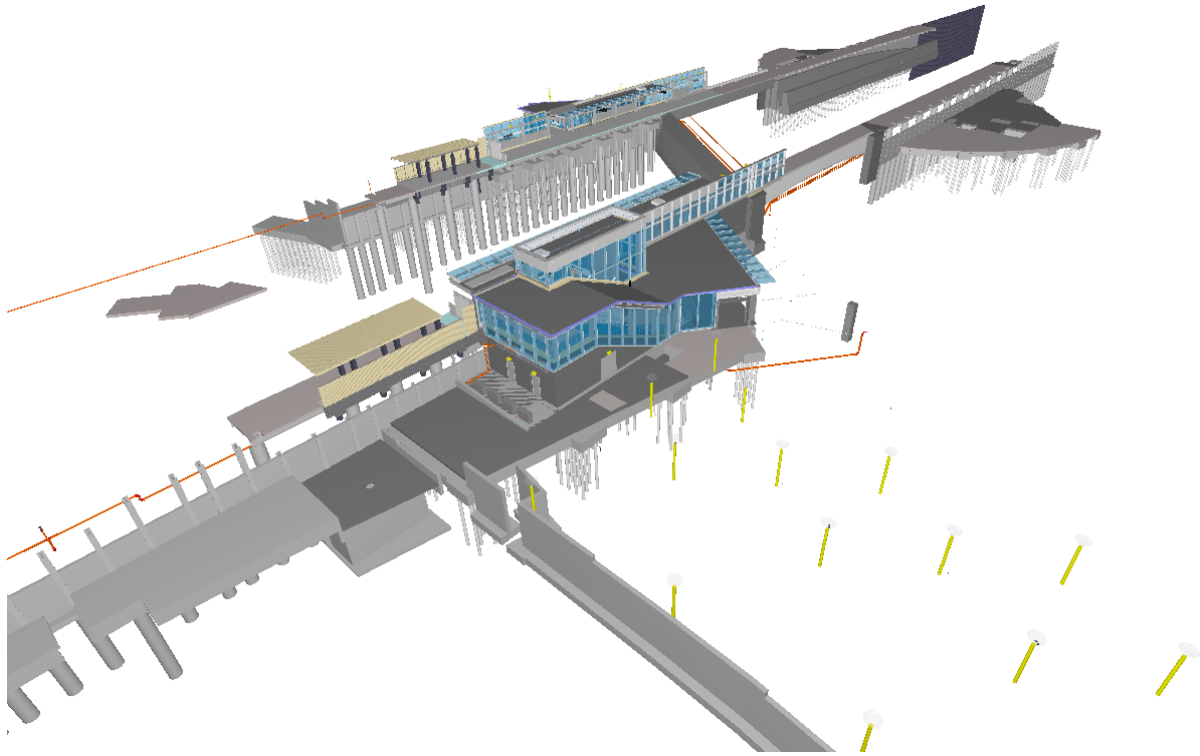
Benefit: Complete asset records for facility management

7D

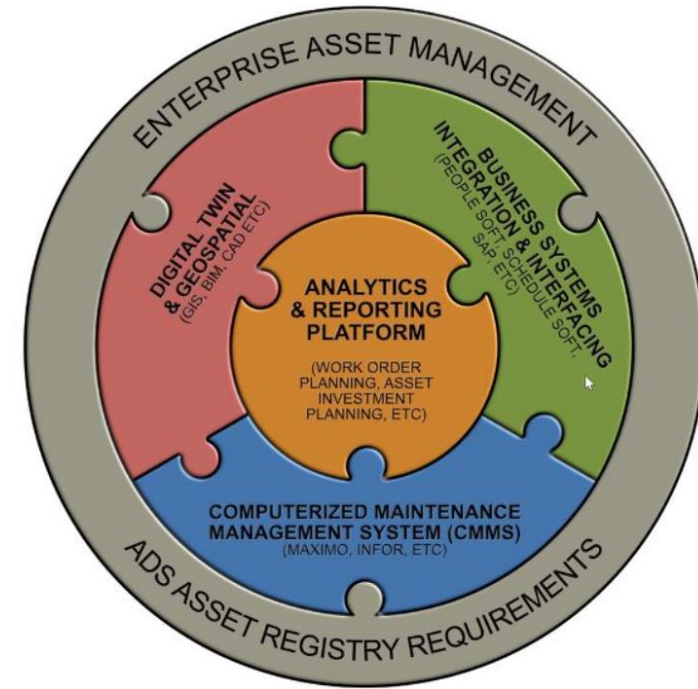
Asset & Operations Modeling



7D - Asset Management Data Model

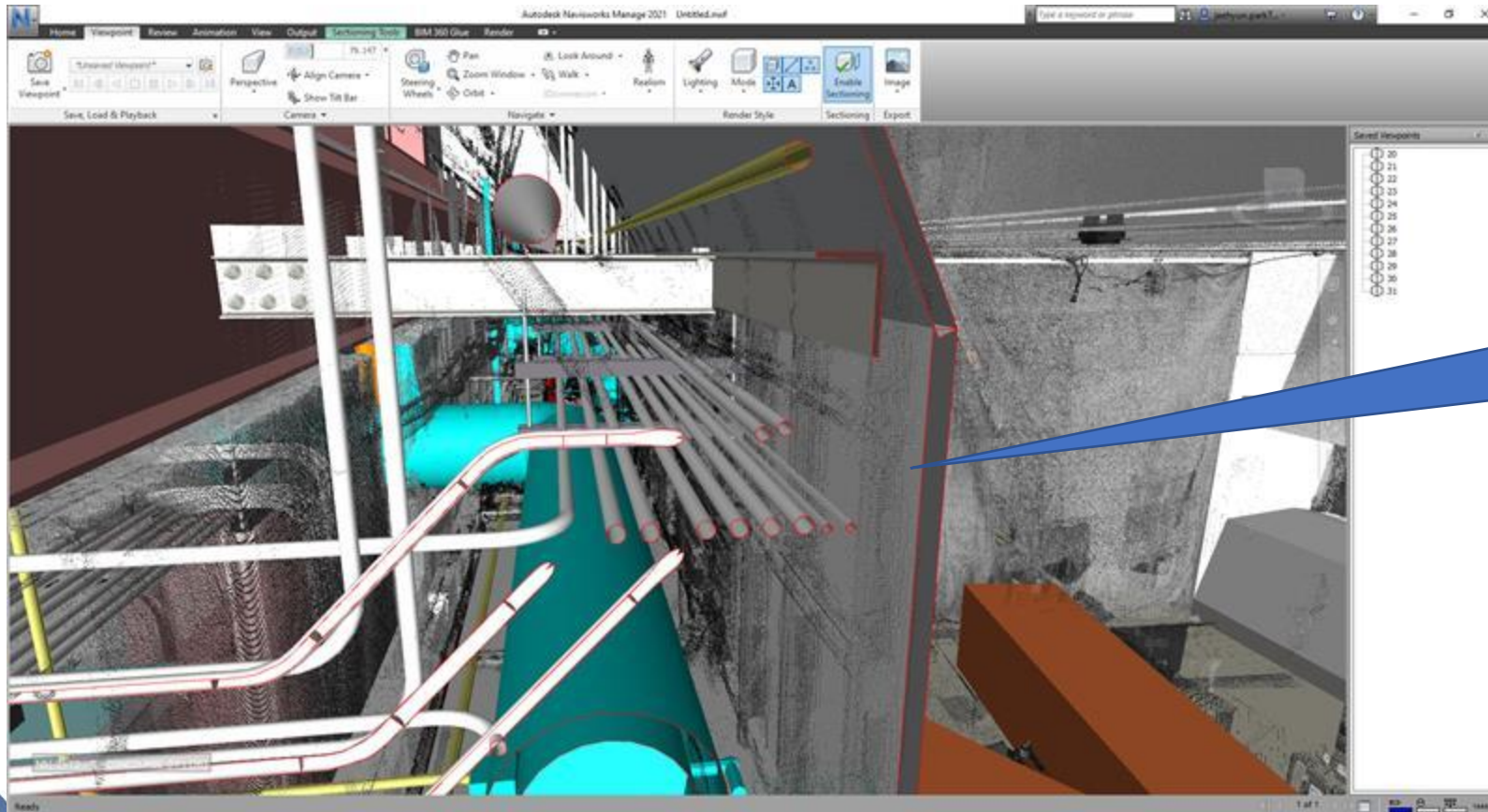


Ensure that all asset data is approved for handover.



Avoid delayed handover due to missing facility information.

As Built Assurance

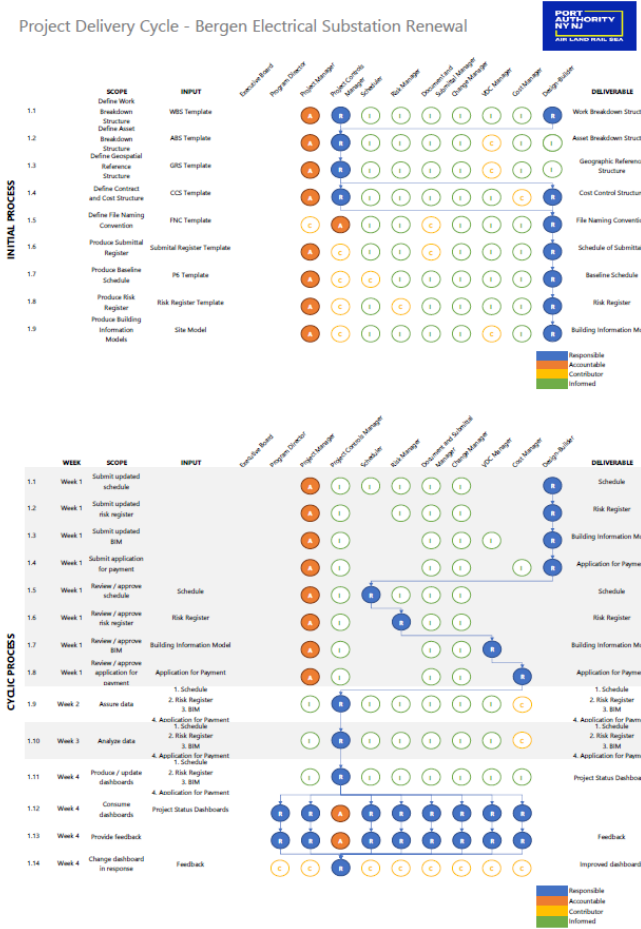
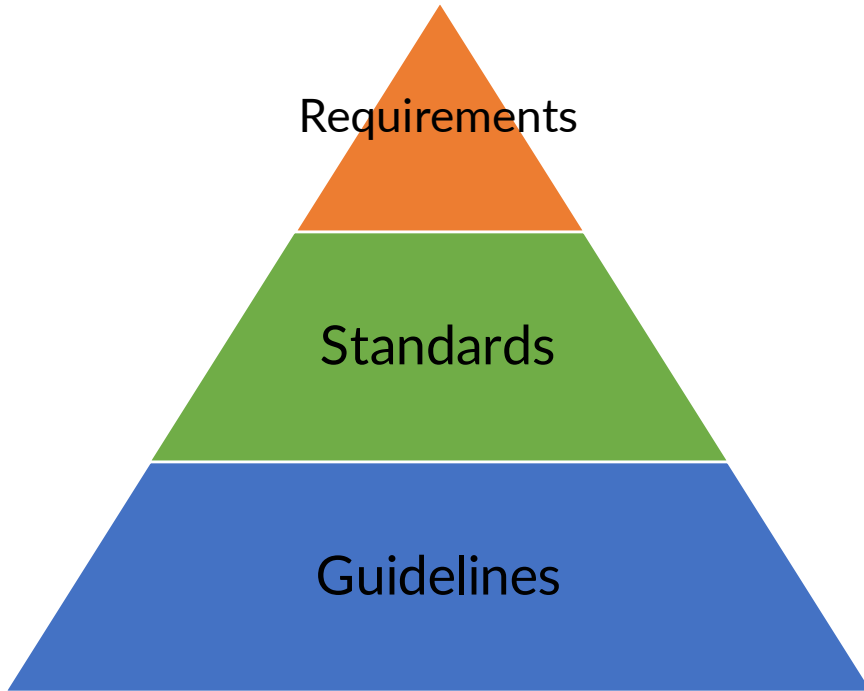


No brace and wrong pipe locations

Standards, Methods and Procedures



Requirements, Standards and Execution Plan



■ Responsible
■ Accountable
■ Contributor
■ Informed

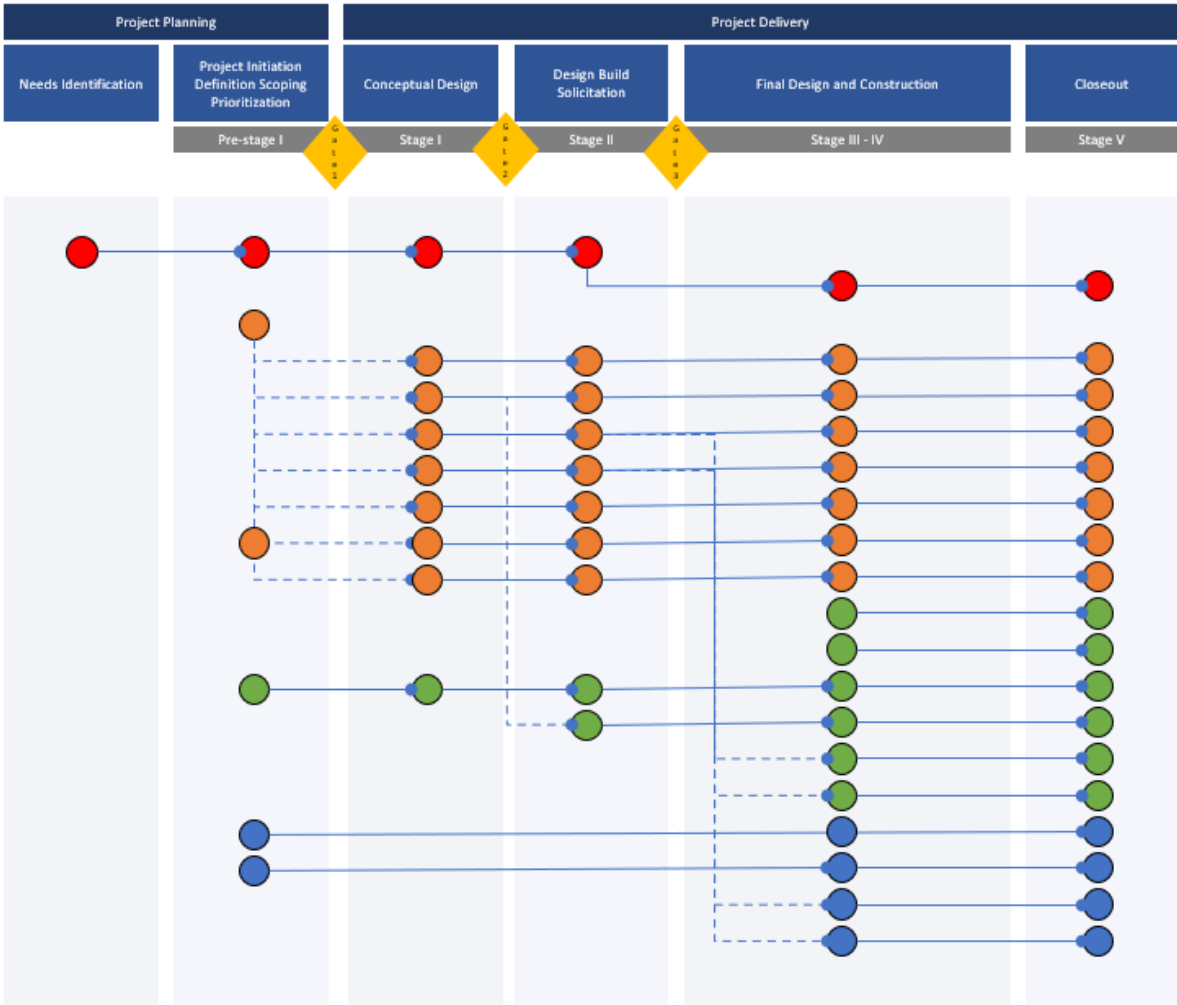
Delivery Roles and Responsibilities



Standard Operating Procedures



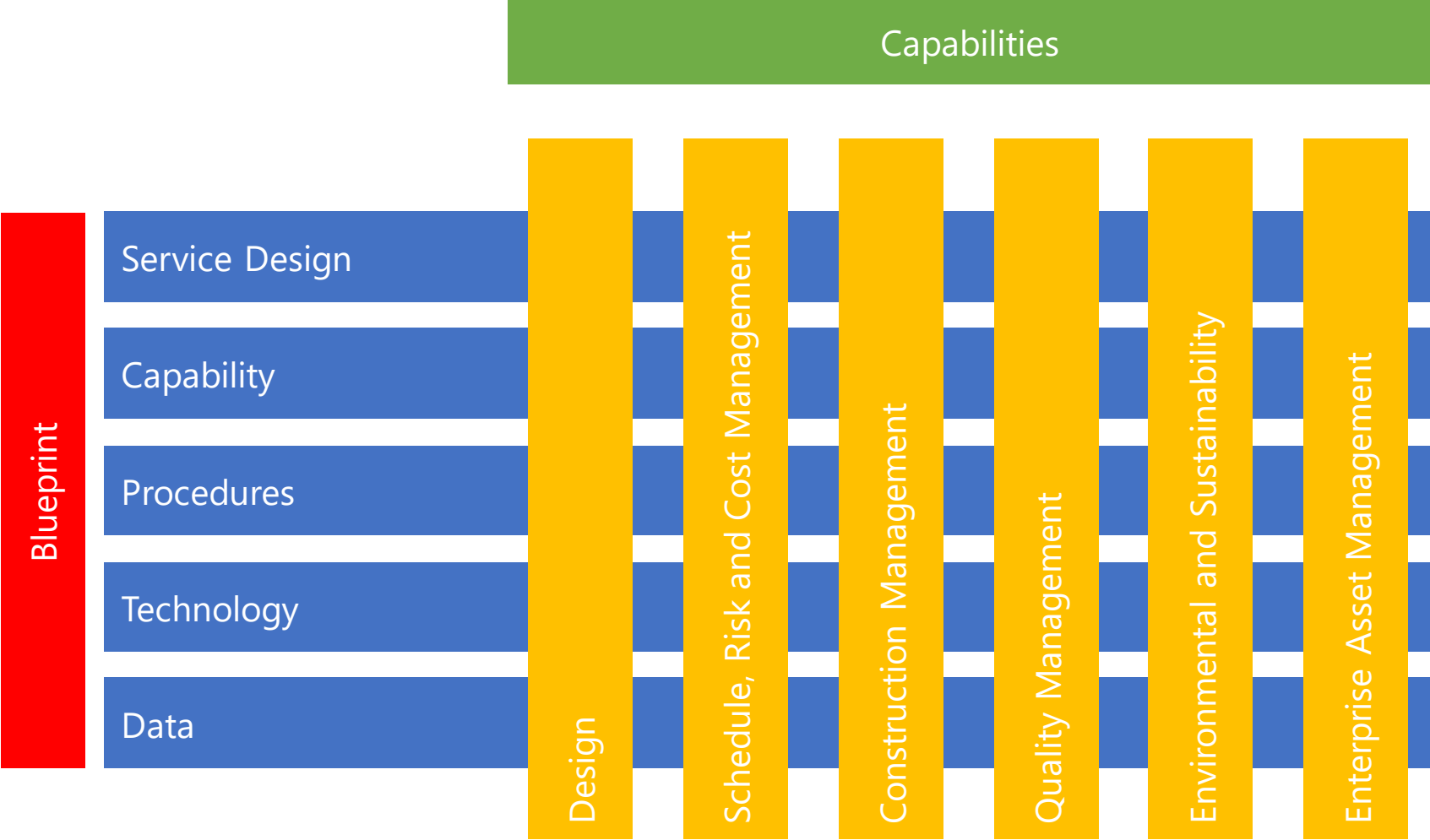
- Procurement
- Contract Administration
- Organization of the Work
- Baseline Approval & Change Control
- Scope Management
- Schedule
- Cost
- Risk & Opportunity Management
- Information Management
- Performance & Reporting
- Quality, Inspection & Testing
- Safety, Health & Environment
- Stakeholder Management
- Design Acceptance
- Work in Place Management
- Record Drawings
- Airport Operations
- Passenger Experience
- Punch List Process
- Final Acceptance & Close Out



Scaling Up



Blueprint



Scaling Up Across the Agency

What are our lessons learned?

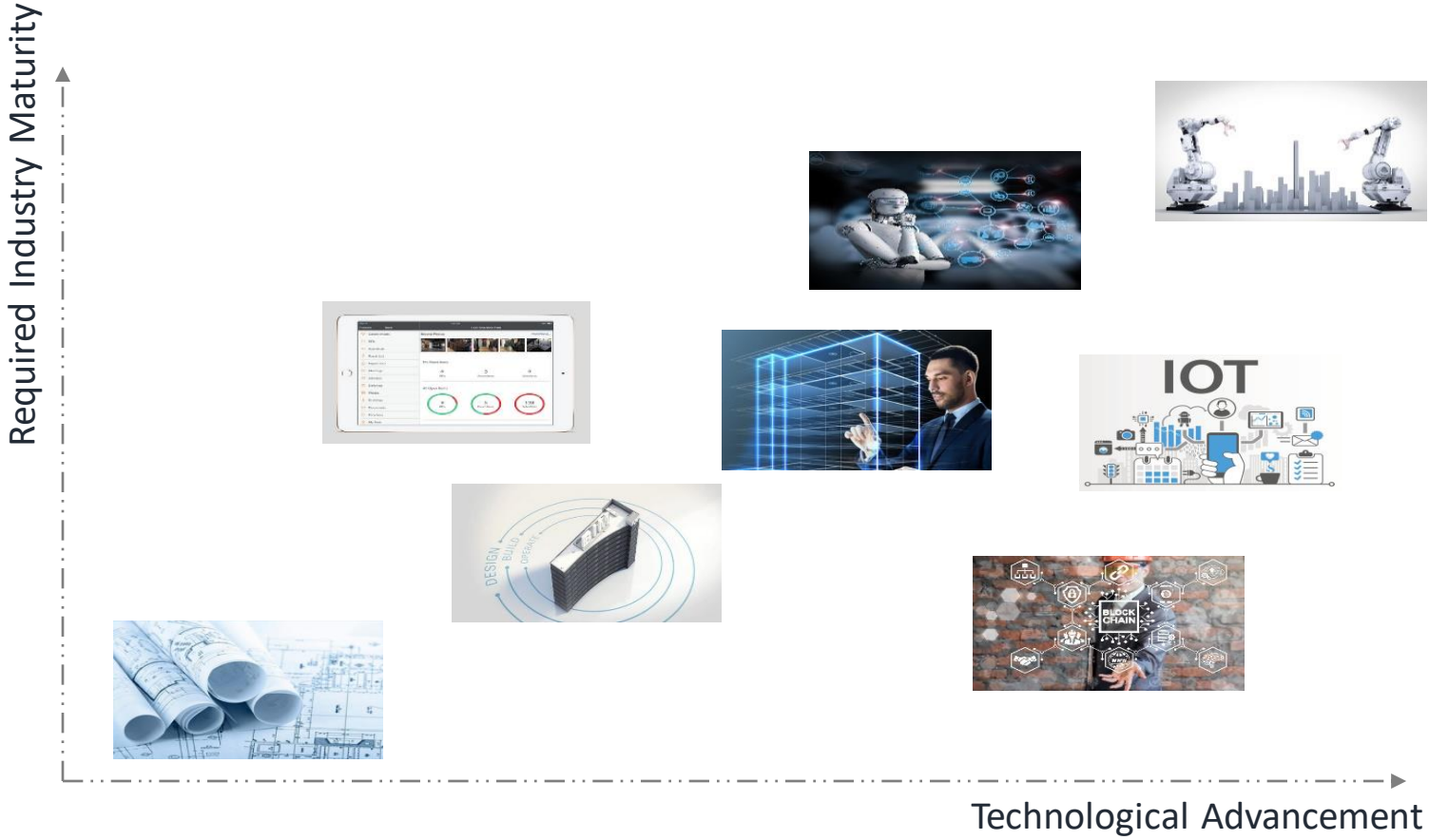
What do we need to do to ensure we can scale up?



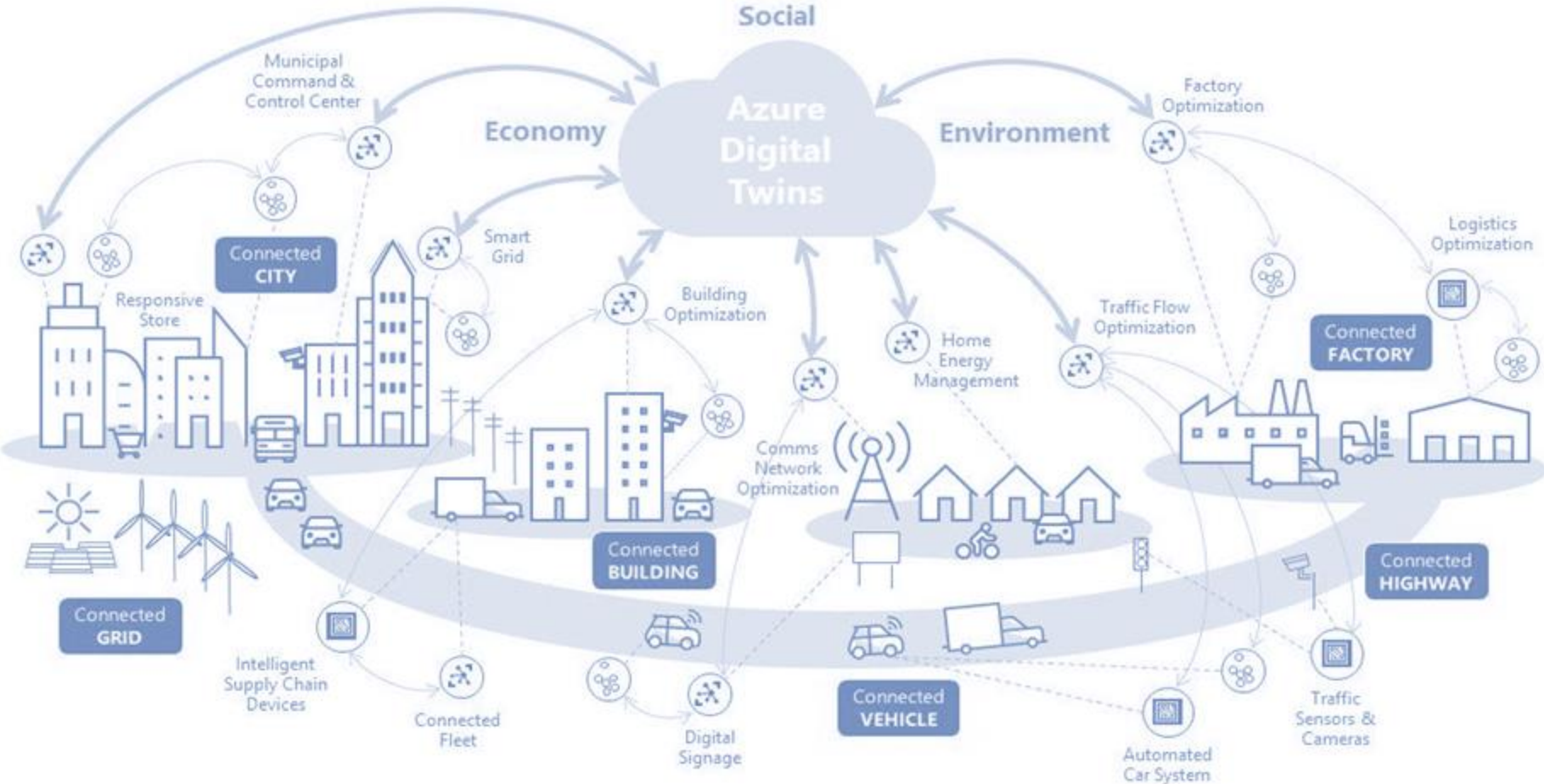
Wrap Up



Technological Advancement



The Future of Connectivity



Engineering Department Connectivity

Instantaneous feedback on
performance of

...design

...construction

...asset in use



Take Aways

1

Digital is **not** technology & does not come *'in a box'*

2

We have a digital transformation strategy in Engineering

3

We are delivering real world outcomes on our projects.



Questions?





THANK YOU